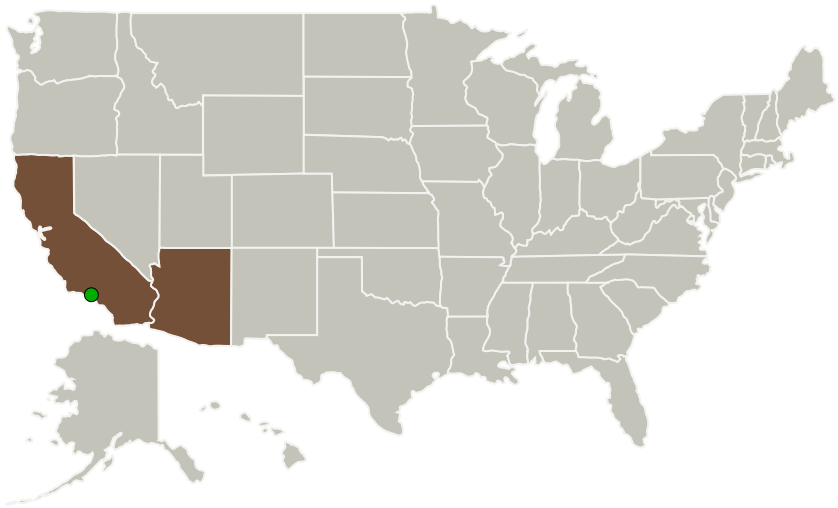
Ultrastable and Compact Deep UV Laser Source for Raman Spectroscopy, Phase II

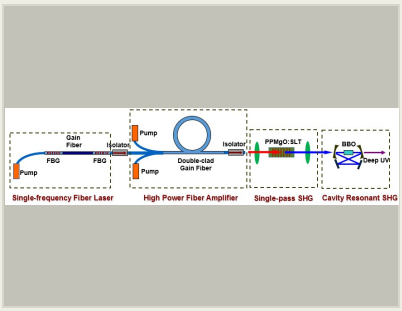
Completed Technology Project (2015 - 2017)

Project Introduction

Deep-ultraviolet (DUV) Raman spectroscopy is a powerful method to isolate and extract the unique signatures of numerous chemical bonds present within complex samples. DUV (λ < 250 nm) excitation is critical for NASA missions because it shows an over 200-fold greater efficiency compared to commonly used 785 nm excitation and illumination as such short wavelengths minimizes the fluorescence background in the Raman spectra. The unavailability of compact, robust, and reliable deep-UV laser sources has constrained implementing DUV Raman spectroscopy in NASA's space-borne exploration and research. TIPD proposes to develop an ultrastable, compact, and robust DUV laser source for Raman spectroscopy based on our demonstrated capability in developing single-frequency fiber lasers and solid-state DUV laser sources. Cooperating with the University of Arizona, TIPD developed an ultrastable and compact single-frequency linearly polarized fiber laser system operating at 976 nm during the Phase I program. The team also developed a single-frequency fiber amplifier at 976 nm and single-pass frequency doubling of 976 nm light to demonstrate the viability of the compact design. Separately, the team has designed and delivered a 150 mW DUV laser for Raman spectroscopy operating at 244 nm using a BBO crystal and a resonant bow-tie cavity based upon a 976 nm VECSEL source. In phase II, the team will scale the power of the 976 nm fiber amplifier to achieve a 5-watt single-frequency output. The 5-watt single-frequency 976nm master oscillator power amplifier (MOPA) will act as the pump to build a 100-mW deep-UV laser prototype that will be delivered to NASA.

Primary U.S. Work Locations and Key Partners





Ultrastable and Compact Deep UV Laser Source for Raman Spectroscopy Project Image

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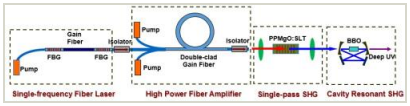
Organizations Performing Work	Role	Type	Location
TIPD, LLC	Lead Organization	Industry	Tucson, Arizona
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California
University of Arizona	Supporting Organization	Academia Alaska Native and Native Hawaiian Serving Institutions (ANNH)	Tucson, Arizona
University of Arizona, College of Optical Sciences	Supporting Organization	Academia	Tucson, Arizona

Primary U.S. Work Locations	
Arizona	California

Images



Project Image
Ultrastable and Compact Deep UV Laser Source for Raman Spectroscopy Project Image
(https://techport.nasa.gov/image/136761)

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
TIPD, LLC

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

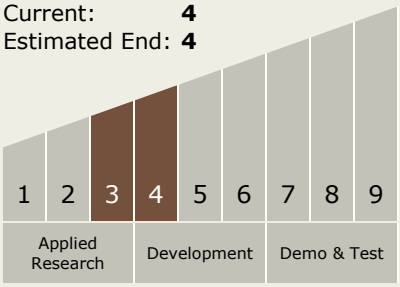
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Valery Temyanko

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.5 Lasers

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System